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On 'The American Clean Energy and Security Act of 2009'

ACESA 2009 and the U.S. National Strategy for Dealing with Climate Change

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The views expressed in this testimony are those of the author alone and do not necessarily represent those of the American Enterprise Institute.

Introduction

Mr. Chairman, Mr. Upton, other members of the subcommittee, thank you for the opportunity to appear before you today. I am Lee Lane, a Resident Fellow at the American Enterprise Institute. AEI is a non-partisan, non-profit organization conducting research and education on public policy issues. AEI does not adopt organizational positions on the issues that it studies, and the views that I express here are mine, not those of AEI.

The draft bill that is the subject of this hearing, The American Clean Energy and Security Act of 2009 (ACESA), is an ambitious attempt to meet the very real challenges posed by rising amounts of greenhouse gases (GHGs) in the atmosphere. Some of the draft bill's goals are unquestionably valid. With climate change, solutions will take time, and hurried action can lead to costly errors. The subcommittee and its members are, therefore, to be commended for their efforts to explore the discussion draft's complex implications.

The ACESA discussion draft is an extremely complex piece of legislation. It is likely, if enacted, to work far-reaching changes on many segments of the American economy. I have not been able to analyze the bill's provisions in detail, nor have I as yet seen modeling results of the kind that would allow an assessment of its economic impacts. My statement, therefore, does not attempt a detailed assessment of ACESA's provisions; rather, it seeks to assess the realism of the main assumptions that seem to underlie the bill's structure and goals. It concludes that the draft bill's approach clashes with four basic realities of current climate policy.

1. **The costs of ACESA's proposed GHG emission reductions would probably exceed their benefits.** The draft bill's many regulatory mandates are, at best, entirely redundant to its cap-and-trade provisions. In other cases they are likely to add costs without adding to the bill's social benefits. Further, the cap-and-trade program is designed to cut emissions deeper and faster than appears to be optimal.

2. **In the short and medium term, the U.S. can do little to bring about an effective global accord on GHG controls.** Simple math reveals that GHG control is better viewed as the subject of a global bargain than as a domestic pollution control issue. ACESA's approach amounts to giving away one of this country's biggest bargaining chips, its expenditures on domestic GHG controls – and to giving it away before the hard bargaining has even begun. The U.S. has not used this approach in previous negotiations on trade, arms, or other important matters – and for very good reasons.

3. **The conditions required to achieve an effective global GHG control accord are, in fact, unlikely to emerge in less than several decades.** The bargaining, monitoring, and enforcement costs of an agreement are high compared with the perceived benefits. The latter are both unevenly distributed and highly uncertain. The repeated failures that have so far marked efforts to reach a climate accord testify to the scale of these difficulties.

4. **The U.S. can and should take action on climate change, but, as in other policy areas, it should tailor its steps to fit its limited resources.** One key to realism is to adopt a patient but serious approach to GHG control. Another is to pay close attention to options that can protect the nation from whatever harmful effects of climate change may unfold. A combination of these approaches can do a good job of protecting U.S. national interests without incurring excessive costs or causing undue conflict with other global powers such as China, India, Japan, and Russia.

Some features of ACESA reflect valid insights. For example, the draft bill is certainly right to place a new stress on adaptation and on advancing technology. My statement will also offer a few suggestions about how these efforts might be made more cost-effective.

The high net costs of the draft bill's GHG reductions

The structure of ACESA virtually assures that it will impose higher than necessary costs to achieve the climate benefits for which it aims.

The needless costs of a combined system

ACESA will consume more resources to achieve its projected GHG reductions than would be required through its cap-and-trade system alone. Several of the bill's provisions apply to activities that are also directly or indirectly subject to the proposed GHG cap. At a minimum, these include the renewable electricity standard, the coal-fired power plant performance standard, and the energy efficiency resource standard.

In some instances these standards may have no effect on emissions. The cap might, by itself, motivate the actions needed to meet the standard. In that case, the standard merely wastes regulatory and compliance costs on purely redundant regulatory mandates.

It is also possible, though, that the mandates could, in some cases, go beyond the actions that the cap-and-trade would motivate. That is to say, the regulations might require steps that would cost more than would the cap-and-trade alone. The GHG cap sets total national emissions; so, if a mandate requires more GHG abatement in one area, less will occur in another. Therefore, society will reap no environmental gain, but the costs of reaching the cap will exceed those which would prevail with only the cap-and-trade in place.

Problems with the cap

While ACESA would be more efficient without its regulatory provisions, the design of the cap-and-trade program is also troubling. Namely, the emission reductions are more stringent and faster than most economic analysis recommends.

The high value that society derives from the use of fossil fuels implies that the costs of making deep and rapid GHG cuts could well exceed the benefits.[1] Although some

controversy remains on this point, most studies have confirmed that this is the case.[2] If so, the best available option would be to tolerate a quite substantial build-up in GHG concentrations. Comparing costs with benefits argues that a modest limit on GHG emissions makes economic sense, but a very stringent one does not. The draft bill is completely at odds with this conclusion.

The draft bill would force tough emission cuts on a fast schedule. This haste flies in the face of a great deal of economic analysis of how GHG reductions should be timed in order to get the most benefit from a given expenditure of resources. That analysis teaches that, for carbon dioxide (CO_2) controls, "a more gradual departure from the [emission] baseline is preferable to a more rapid departure."[3] Yet, in this respect, ACESA's controls are more abrupt than those of even President Obama's cap-and-trade plan.

Moreover, high expectations about the rate of future innovation should imply smaller GHG cutbacks in the program's early years.[4] The more one believes that innovation will lower future control costs – and without dramatically lower costs the bill's 2050 target is wholly fanciful – the larger the share of the total GHG cutbacks that should be deferred until the program's later years. In short, ACESA misses a chance to lessen total abatement costs by spreading them through time in a smarter way. Two prominent economists have recently made the broad point that should be heeded in this regard, "…the climate change problem is a marathon, not a sprint, and there is little environmental justification for heroic efforts to meet a short-term target. Such heroic efforts might not only waste resources, they risk souring our appetite to confront the more serious long-term problem."[5]

These steep reductions have another drawback. If the U.S. adopts GHG controls that are more stringent than those of one or more other major economic powers, its efforts will be partially offset by emissions leakage. Leakage is the flight of GHG-intensive activities to other nations that impose no controls or controls that are laxer than those in the U.S. Leakage can occur either through increased imports or decreased exports. One recent study found that leakage would offset between 14 percent and 25 percent of the Obama cap-and-trade plan's U.S. GHG reduction.[6] In effect, leakage will cancel out 14-25 percent of each tonne of GHG discharge avoided by domestic GHG limits. Because of this, the cost of avoiding a tonne of GHG emissions under a unilateral American program will be 16-33 percent greater than that reflected in the domestic abatement cost.

Limits on U.S. influence on global GHG control

ACESA considers the problem of leakage and proposes a number of measures in Title IV, Part 2, Section 412. In the next section, Section 413, the draft wisely concludes, "Congress finds that the purposes described in Section 412 can be most effectively addressed and achieved through agreements negotiated between the United States and foreign countries." Actually, that finding should be applied to the entire scope of Title IV. That is to say, effective GHG control regime, by its very nature, requires international agreement. Yet ACESA, as domestic legislation, can mandate only U.S. action.

GHG control, predominantly a foreign policy problem

Unless ACESA causes other nations to adopt GHG limits, it is focused on what is, in fact, the much smaller and shrinking part of the total problem. Effective GHG control depends far more on inducing controls abroad than it does on imposing them at home. When all greenhouse gases are considered and all sources, including land use changes, are counted, the U.S. is contributing only about 15 percent (and falling) of global GHG emissions.[7] The other 85 percent is beyond the control of the U.S. government.

China and India pose a great challenge to efforts to deal with the 85 percent of the task that lies beyond direct U.S. control. Their governments refuse to shoulder the costs of GHG curbs, and as long as those costs remain as high as they now are, China, India, and similar countries are likely to continue to decline to pay them. That decision is rational; their governments are largely free from domestic pressures to adopt controls.

As long as they continue to practice what is, in effect, climate *Realpolitik*, the U.S. has only four options for attempting to construct a global GHG control pact. None of them is likely to have a more than marginal impact on emissions. ACESA seems to draw, in varying degrees, on all four approaches.

Unilateral action and moral suasion

First, the U.S. could enact go-it-alone GHG controls and trust the moral appeal of its example to sway other nations.[8] While it is clearly true that the U.S. could not expect China and India to bear the costs of curtailing their GHG discharges unless it were willing to do the same, it is quite another thing to leap from that statement to the assertion that the U.S. should act without firm pledges that other states will respond in kind.

The audacity of this leap has often been missed, but it merits real scrutiny. Does the United States conduct any other negotiation in this way? Did Congress, for example, as a prelude to the Uruguay or Doha Rounds, drop all U.S. tariffs and farm subsidies to zero? Did the U.S. win the withdrawal of Soviet conventional forces from Europe by first pulling its own troops out of Germany? Why, then, would we consider taking the functional equivalent of these steps in the area of GHG control? Or, to pose the same question in another way, how would ACESA's GHG reductions differ from the just-mentioned bargaining moves in trade or arms control?

No one can claim that the answer is that the Chinese and Indian governments have signaled their readiness to respond in kind to U.S. GHG curbs. To the contrary, they continue to insist that the developed countries must commit to pay them for any control costs that they incur.[9] The Chinese and Indian governments' statements are consistent with their behavior. These countries are clearly more interested in dodging the costs of GHG curbs than in capturing the gains from a global control regime.

ACESA could only harden their resolve. As other countries adopt GHG limits, China and India will make competitive gains by simply standing pat against controls. Over time, energy-intensive industries will migrate to the nations that reject controls. The growth in

these states of energy-intensive capital and jobs will add to the political costs of any future move toward controls.[10] This outcome is the very opposite of the one that the U.S. should be seeking.

Trade sanctions

Second, many proponents of U.S. GHG controls have proposed to allow the U.S. government to clap trade sanctions on countries that fail to cap their GHG discharges. ACESA also follows this strategy, albeit somewhat hesitantly. There are better grounds for the bill's hesitancy than there are for believing that trade sanctions will change Chinese and Indian policy.

One country adopting trade sanctions, or a few countries doing so, will merely change the geographic pattern of trade flows. It would do little net harm to China and India. As GHG controls raised U.S. production and transport costs, countries like Japan with low-carbon processes for producing steel, aluminum, or other energy-intensive goods would raise their exports to the U.S. At the same time, these countries could boost their own imports from China and India to fill the gap left by their higher exports. The Chinese and Indians would be largely indifferent to the change. The threat of U.S. action will, therefore, put little pressure on them.[11]

Paying China and India for GHG abatement

Third, the U.S. could offer to pay for China's GHG reductions as well as its own. Although some ACESA provisions amount to paying other nations to reduce GHG emissions, the bill does not appear to envision the kind of very large transfer payments that the China/G-77 group is demanding. In their view, past U.S. emissions are a kind of historical guilt, and contemporary Americans should pay to expiate our ancestors' sins.[12]

The case for this demand is hollow. It rests, in part, on the false proposition that developing countries have added almost nothing to current atmospheric GHG stocks. The reality is quite different. The group of currently poor countries and the group of currently rich countries have each placed about the same amount of GHGs in the atmosphere.[13]

Confusion about this point stems from three mistakes. First, many studies consider only industrial sector emissions. Most of the poorer countries' emissions stem from land use changes, agriculture, and animal husbandry, so they are not counted. Second, studies often look only at CO_2. Poorer countries tend to have large methane emissions; again their contribution is missed. Third, many studies have lumped those poor countries with high emissions with the many poor countries that have virtually none. The regional averages mask the true state of affairs. Cumulatively, these errors have created a badly distorted impression of the origins of today's atmospheric GHG stocks.[14]

Furthermore, the situation is changing rapidly. The balance ten years from now will be much different than that which prevails today. The latter is simply irrelevant to decisions about who should pay to reduce future emissions. To the contrary, attempting to interject

claims about the historical record is more likely to lead to stalemate and endless wrangling than it is to build consensus. It is hard to see why the U.S. would want to give credence to this approach.

Exaggerating the extent of other nations' GHG reductions

Fourth, some may be tempted simply to pretend to believe that a mix of Chinese or Indian "no-regrets" policies constitutes serious action on GHG controls. (No-regrets policies are those that would be rational to adopt even in the absence of concerns about climate change.) China and India, for reasons unrelated to climate, are very likely to adopt such policies. Their economies exhibit very low energy efficiency. They enjoy many options for making energy savings that will be cost-beneficial quite independently of concerns about climate.[15] Chinese and Indian actions to reduce this waste are, therefore, properly regarded as corrections to the estimates of their baseline GHG growth; as such, they are welcome. They are, however, not done in response to U.S. action, and they will affect GHG growth paths only at the margin.

An effective global deal on GHG control is unlikely

The conclusion seems inescapable. The U.S. can have little impact on when China and India become willing to bear the costs required to control GHG discharges. This limit on America's options reflects a basic reality: Conditions are not yet ripe for forging an effective global accord on GHG controls. To understand why this might be so, we might want to consider the economic roots of the GHG control issue.

Open access property rights and GHG emissions

Excess GHG emissions are an example of a fairly common kind of market failure, a failure often called the "tragedy of the commons". It can arise when property rights allow open access to a valuable resource. Instances include open access to grazing land or fishing grounds or to oil and gas reservoirs. Open access can cause under-investment in the resource and too much consumption of it.[16]

In the case of climate, the open access resource is the atmosphere's capacity to absorb GHG discharges. Those who gain from the actions that release GHGs reap the full benefit of using the atmosphere in this way, but they incur only a negligible percentage of the total costs, *i.e.* their personal share of any harm done by their increment to global climate change.

Because of this mismatch of private and social costs, agents maximizing private net benefits will overuse the atmosphere's GHG disposal capacity. Cumulatively, emission levels exceed those at which the additional risk of climate change would just balance the value of the gases' disposal. And investments in carbon 'sinks' like forests or carbon stored in soils are falling below optimal levels.

Limiting open access property rights is difficult

To reach an agreement on collective action, the parties must believe that the new distribution of property rights offers them benefits that will exceed the sum of the new arrangement's costs to them plus the costs needed to negotiate, monitor, and enforce the agreement. (Economists call the latter "transaction costs.") By inference, high transaction costs can scuttle agreements on readjusting property rights in ways that, were it not for the transaction costs, could yield net benefits for all parties. It is precisely this problem that has caused the failure of many attempts to curtail exploitation of the common-pool resources.[17]

The record of collective action on other open access problems

In principle, collective action could solve the problem by changing property rights to limit access. In practice, such collective action has often not materialized, or it has done so only after much harm has taken place.

For example, wild ocean fish stocks are being seriously depleted. Even within national territorial waters, restraints on over-fishing have often been eroded over time. Curbs on over-pumping of oil and gas resources have sometimes worked, but often they have only done so after a great deal of economic waste had already occurred.[18]

The frequency of failures to replace open access property rights is suggestive. Open access arrangements are notoriously prone to wasteful overuse. If they remain in place, the transaction costs of changing the property rights regime must be quite high relative to the value of the resource.

The record of collective action on GHG controls

The record of GHG controls has been no more effective than attempts to control over-fishing and other similar problems. Global emissions of CO_2, the most important industrial greenhouse gas, currently exceed the 1988 level by over a third.[19] The IPCC and NOAA report that, through the last several decades, the rise in atmospheric concentrations of CO_2 has sped up.[20]

Many Europeans blame the United States for this lack of progress. In Europe, the social demand for action on climate appears to be stronger than it is in the United States.[21] Yet, even in Europe, GHG reductions have not been nearly as sharp as those stipulated by the Kyoto Protocol.[22] European leaders harshly criticized America's rejection of the Kyoto Protocol. Economically, though, for the U.S., the Protocol's costs would have more than outweighed its benefits.[23] Politically, its high costs clearly exceeded the rather low U.S. national willingness to pay – a mismatch that doomed its chances for acceptance.[24] The experience raises a question about whether the conditions that would permit a better outcome are yet in place.

Features of GHG controls that impede collective action

Unfortunately, GHG control seems to have many of the features that complicate efforts to restrict open access to resources, and these features raise real doubts about when an effective agreement might be expected.

Diverse interests raise the transaction costs of reaching agreement

In problems of this kind, the more diverse are the interests of the parties, the poorer are the prospects for success.[25] Contrasting value judgments often cause conflict.[26] With GHG controls, the differing interests of rich and poor nations have emerged as especially problematic.[27]

While some governments regard GHG control as high priority, others have concluded that paying to curb domestic GHG discharges is not, at least for now, in their interest. For many poorer nations, economic development offers better protection from harmful climate change than do GHG limits. This choice makes sense. Industrialization can boost the ability to adapt to climate change. Of course, it can also relieve many other more acute problems. For these countries, slowing growth in the name of GHG control may simply be a bad investment.[28]

Then too, the governments of China and India may lack the popular support that they would need to be able to bear the political costs of GHG controls. Their governments have often gone to great lengths to hold energy prices *below* world levels.[29] To now drive domestic energy prices above world market levels would be a daring political gamble.

Many participants make agreement more difficult

Sheer numbers also matter. All else remaining equal, the more parties that must agree, the more complex the negotiation is likely to be. That is one reason that the wider the geographic extent of the open access resource, the harder it will be to restrict access to it.[30] With GHG control, the resource is literally the sky – not something to which access is very easy to limit. All nations, however unequal in other regards, have access to the sky.

Today, counting the E.U. as a single entity, perhaps fifteen to twenty nations around the world are major sources of GHG discharges. Agreement is already difficult, but the real test lies in the future. Economic growth will swell the number of major sources. Eventually, participation has to be nearly universal, or countries without controls are likely to become magnets for GHG-intensive activities.[31] Essentially, a great many nations have, or will eventually gain, an effective veto over global GHG control efforts.

The limited net benefits of GHG controls

As already discussed, for GHG controls to yield net benefits at all, they must be fairly moderate. In that case, the total benefits of controls, although positive, are also modest. In this regard, GHG controls contrast sharply with the control of ozone-depleting chemicals. With the latter, optimal controls yielded quite large net benefits. The much smaller net gain available from GHG control restricts the range of options for deal making.[32]

The cost of information about the benefits of agreement

Costly information – or information that is not available at any price – can exacerbate the problem posed by thin net benefits. Continuing uncertainties about the impacts of climate change clearly discourage agreement on GHG controls. Not only do large uncertainties persist about the global costs and benefits of GHG controls; even more doubt obtains on a nation-by-nation basis.[33] These uncertainties impede action, and they are likely to do so for as long as they remain at their currently high level.[34] The progress of climate science may over time dispel these uncertainties, but, so far, the process has been a slow one.

Climate science, moreover, will do nothing to dispel doubts about whether an agreement would be enforced. Such doubts clearly diminish the perceived value of reaching agreement.[35] And the grounds for such doubts are solid. They are especially so with respect to the developing countries.[36] Today, China's government has a strong economic motive to assure the safety and purity of its exports. The U.S. government is also concerned, and yet the safety of toys and food imported from China clearly remains problematic.

In GHG control, the Chinese government would have no real interest in transparency. Could the U.S., especially in that case, accurately determine how much coal China is burning? Could it know if a carbon tax has been enforced on state-owned enterprises in Qinghai? Could it ensure that such a tax had not been offset with concealed subsidies? Neither China's record, nor America's, reassures on these points.

Climate policy realism

To all appearances, then, GHG control requires action on a global scale, and most of what we know about efforts to restrict open access property rights tells us that a strong global GHG control pact will be an especially difficult challenge. Yet climate change is a threat, even if assessing its severity and timing remains difficult. U.S. climate policy can do no better than to make the best of the options that are actually available, even if they fall far short of offering final solutions.

Putting a modest price on GHG emissions

The high costs of GHG abatement are a major source of the difficulty in reaching consensus on GHG control. New technology can lower these costs. Fostering the relevant kinds of innovation, therefore, should be a top priority. Implementing a modest carbon tax or, perhaps, a hybrid cap-and-trade system, would be an important step toward this goal. A price on GHG discharges would encourage the private sector to develop new lower-cost ways of curbing GHG emissions.[37]

At the same time, as already discussed, many factors constrain the level of the price on GHG emissions. The price should, therefore, be a modest one, and it should replace regulatory mandates, not supplement them. In order to keep the proper focus on the global nature of the climate problem, the price should be linked to GHG prices in China

and India. At least in the early years, the U.S. price may have to slightly exceed those in China and India, which are likely to be zero, but the gap should be small and, in order to avoid creating perverse incentives for other nations, it should not be permitted to increase.

The need for funding basic energy science

While a price on GHG emissions would encourage some helpful kinds of innovation, it will not generate other kinds. Coping with climate change will require major breakthroughs in basic science.[38] Such breakthroughs are often elusive, and seeking them is an inherently high-risk venture. The private sector finds it difficult to capture the economic rewards of funding basic science, and placing a price on GHG emissions will not correct this bias. As a result, the private sector usually does not make large, sustained investments in basic science; yet that kind of investment is the key to achieving the breakthroughs needed in climate policy.[39]

Some form of government funding will be necessary to call it forth.[40] Government, though, has often short-changed basic energy science in favor of large demonstration projects. It has also found it difficult to avoid wasteful stops and starts in funding.[41] There may be a productive role for properly structured demonstration projects, but the premature move to that stage has often been associated with costly failures. Making large public investments in plug-in vehicles before it is clear that carbon capture and storage can be economic has at least the appearance of just such a rush to demonstration. There is also a serious risk that the high costs of demonstration projects will generate budget pressures that will cause the politically less appealing basic research to be starved for resources. [42]

The ACESA provisions on technology forcing should be reviewed in light of the findings of a recent conference on climate and technology conducted at Stanford University. Among these findings attendees agreed: "The single greatest impediment to an R&D program that is directed at achieving a commercial objective is that it will be distorted to deliver subsidies to favored firms, industries, and other organized interests. The best institutional protections for minimizing these distortions are multi-year appropriations, agency independence in making grants, use of peer review with clear criteria for project selection, and payments based on progress and outputs rather than cost recovery."[43]

Limit international agreements to areas where agreement exists

The United States should engage other nations on climate change. More than a few opportunities for agreement may exist. A global pact on GHG caps with full trading of allowances is almost certainly not among them, nor, in my opinion, would it be desirable.

Trying to push China and India into going much beyond their current no-regrets policies will almost certainly prove futile, and it might well be counter-productive. On the one hand, it is possible that Chinese and Indian societies are destined to evolve in ways that will awaken internal demands for GHG controls. If they are, U.S. incentives could easily delay that progress. Sanctions could provoke resentment; bribes could induce a sense of

entitlement and incentives for strategic behavior. On the other hand, if China and India are not destined to develop an indigenous demand for GHG controls, or if they will do so only very slowly, the U.S. can do even less to change the course of events. Climate is clearly an instance to which the president's call for a more humble U.S. foreign policy should be taken to heart.

In the meantime, a negotiation that allows countries to make and trade-off a wide variety of relevant actions might make far more sense than one in which all transactions have to take place in the coin of emission caps. Some countries with strong green lobbies might still wish to offer caps. Others might pledge R&D spending, sectoral GHG caps, aid to poor nations for adaptation, or more funding for climate science.

This approach, much like a trade negotiation, would make monitoring compliance with nations' pledges easier. It would also make penalties of failing to perform agreed actions more credible.[44] At the same time, one must admit that such a negotiation would not produce the dramatic GHG reductions craved by the green groups, but, then again, no other form of negotiation is likely to produce that result. It makes no sense to condemn modest real progress because it does meet an unrealizable ideal.

On other aspects of climate policy, prospects for technology cooperation may also be good. The U.S. may wish to coordinate with other industrialized nations to help to boost the adaptive capacity of poorer states. There is no reason to forego progress in these areas while waiting for a global deal on GHG caps, a deal that may be decades away.

Give priority to adaptation

A sizeable amount of climate change is at least possible. There is no good reason not to seek to minimize its net costs.

ACESA is correct to stress adaptation

ACESA makes a valuable contribution in highlighting the importance of adaptation. Fortunately, much can be done to minimize the social costs that climate change might otherwise cause. Indeed, for the next century, adaptation to climate change is likely to do more to reduce its costs than will GHG controls.[45] America is especially well-endowed with the human and other capital required to make the needed adjustments.

The prompting of the federal government will not be necessary for the private sector and state and local governments to undertake many of the needed adjustments.[46] Generating and diffusing this kind of scientific knowledge should be a top priority of the federal government. In this regard, too, ACESA has found the right priority.

Need to research geoengineering as a possible means of adaptation

A family of technologies, known collectively as 'geoengineering', might provide an added tool for adaptation. The idea behind them is simple. When sunlight strikes the Earth's surface, greenhouse gases in the atmosphere trap some of the heat that is generated. A slight decrease in the amount of sunlight reaching the Earth's surface could,

in principle, offset this warming. Scientists estimate that deflecting a small portion of the total sunlight that strikes the Earth back into space would be enough to cancel out the warming effect of doubling the pre-industrial levels of greenhouse gases.[47]

Scattering this amount of sunlight may be fairly easy. Past volcanic eruptions have shown that injecting relatively small volumes of matter into the upper atmosphere can scatter enough sunlight back into space to cause discernable cooling. The 1991 eruption of Mt. Pinatubo reduced global mean temperature by about .5 degrees Celsius. This temperature reduction was apparent in just a few months and persisted for about three years.[48]

Some scientists propose, therefore, to use modern technology to create a carefully engineered analogue to this effect. Proposals to seriously study geoengineering are gaining adherents among climate policy experts. In late 2006, NASA and the Carnegie Institution jointly sponsored a high-level expert workshop on the subject. Scientists such as Ralph Cicerone, Paul Crutzen, and Tom Wigley and prominent economists such as Scott Barrett, William Nordhaus, Thomas Schelling, and Lawrence Summers have argued that the concept warranted further exploration.[49] Recently, an expert conference conducted at Stanford added the voices of several more distinguished economists to this list.[50] John Holdren, the president's new science advisor, recently added his voice to this cause while also noting the many uncertainties that still surround these approaches.

Conclusion

In sum, ACESA represents an ambitious attempt to grapple with a real problem. The draft bill's recognition that more is needed to tackle the problem than just GHG controls is welcome. In principle, the bill is certainly correct to stress the importance of technology in seeking a long term solution to climate change. In practice, the rush into multiple demonstration projects is likely to carry real risks.

The bill's stress on adaptation, and on the science needed to unleash action in this area, is commendable. Geoengineering may greatly extend the capacity to adapt to climate change. Research into its potential and its possible risks should be part of a well-designed effort on adaptation.

The primary weakness of ACESA is its GHG reduction program. The U.S. should, indeed, put a modest price on GHG emissions, but ACESA's abatement costs are likely to be far too high. Its regulatory mandates can only increase the net costs, and ACESA's goals are at odds with the strategic logic of the GHG control problem, which is essentially the subject of an international bargain about cost sharing.

Endnotes

[1] Kelly, David L. and Charles D. Kolstad. "Integrated Assessment Models for Climate Change Control" in *International Yearbook of Environmental and Resource Economics 1999/2000: A Survey of Current Issues*, H. Folmer and T. Tietenberg (eds). Cheltenham: Edward Elgar, 1999; 19.
[2] Nordhaus, William D. *A Question of Balance: Weighing the Options on Global Warming Policies*. New Haven: Yale University Press, 2008.
[3] Richels, Richard G., Alan S. Manne, and Tom M.L. Wigley. "Moving Beyond Concentrations: The Challenge of Limiting Temperature Change." AEI-Brookings Joint Center for Regulatory Studies, Working Paper 04-11, April 2004; 16.
[4] Ibid.
[5] Hubbard, Glenn R. and Joseph Stiglitz, "Letter to Senators John McCain and Joseph Lieberman," June 12, 2003.
[6] Leakage numbers generated from CRA's international macroeconomic model, MS-MRT (Bernstein, Paul, David Montgomery, and Thomas Rutherford (1999). "Trade Impacts of Climate Policy: The MS-MRT Model." *Energy and Resource Economics*, 21: 375-413).
[7] Weisbach, David A. (2009). "Responsibility for Climate Change, by the Numbers." University of Chicago Law & Economics, Olin Working Paper 448.
[8] Helme, Ned. "Preparing for Copenhagen: How Developing Countries are Fighting Climate Change." Statement to the Select Committee on Energy Independence and Global Warming. 4 March, 2009.
[9] United Nations Framework Convention on Climate Change (2008). "Paper No. 3: Philippines on Behalf of the Group of 77 and China – Financial Mechanism for Meeting Financial Commitments under the Convention" in "Ideas and Proposals on the Elements Contained in Paragraph 1 of the Bali Action Plan;" 35-37; UNFCCC (2008). "Paper No. 1: Antigua and Barbuda on Behalf of the Group of 77 and China – A Technology Mechanism under the UNFCCC" in "Ideas and Proposals on the Elements Contained in Paragraph 1 of the Bali Action Plan;" 6-9; UNFCCC (2009). "China's Views on the Fulfillment of the Bali Action Plan and the Components of the Agreed Outcome to be Adopted by the Conference of the Parties at its 15th Session"; UNFCCC (2008). "Supplemental Submission by India: Why Financial Contributions to the Financial Mechanism of the UNFCCC Cannot be Under the Paradigm of 'Aid'".
[10] Jacoby, Henry D., Ronald G. Prinn, and Richard Schmalensee (1998). "Kyoto's Unfinished Business." *Foreign Affairs* 77(4): 54-66.
[11] Houser, Trevor, Rob Bradley, Britt Childs, Jacob Werksman, and Robert Heilmayr. *Leveling the Carbon Playing Field: International Competition and US Climate Policy Design*. Washington, DC: Peterson Institute for International Economics, World Resources Institute, 2008; 76.
[12] Weisbach, David A. (2009). "Responsibility for Climate Change, by the Numbers." University of Chicago Law & Economics, Olin Working Paper 448.
[13] Ibid.
[14] Ibid.
[15] Montgomery, David and Sugandha D. Tuladhar (2006). "Making Economic Freedom Central to the Asia-Pacific Partnership." CRA, International.
[16] Eggertsson, Thráinn. "Open Access versus Common Property" in *Property Rights: Cooperation, Conflict, and Law*, T.L. Anderson and F.S. McChesney (eds). Princeton: Princeton University Press, 2003; 77.
[17] Coase, Ronald (1960). "The Problem of Social Cost." *Journal of Law and Economics* 3(1): 1-44.
[18] Libecap, Gary D. "State Regulation of Open-Access Common-Pool Resources" in *Handbook of New Institutional Economics*, C. Menard and M.M. Shirley (eds). Dordrecht: Springer, 2008; 545-546.
[19] Energy Information Administration. *International Energy Outlook 2006*. Table H.1, World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1980-2006.
[20] Intergovernmental Panel on Climate Change. IPCC Data Distribution Centre, Carbon Dioxide: Projected Emissions and Concentrations. Available at http://www.ipcc-data.org/ddc_co2.html; National Oceanic and Atmospheric Administration. "Atmospheric CO_2 at Mauna Loa Observatory." Available at http://www.esrl.noaa.gov/gmd/ccgg/trends/co2_data_mlo.html.

[21] Böhringer, Christian and Carsten Vogt (2002). "Dismantling of a Breakthrough: The Kyoto Protocol – Just Symbolic Policy!" ZEW Centre for European Economic Research, ZEW Discussion Paper 02-25; Pew Global Attitudes Project. "America's Image Slips, But Allies Share U.S. Concerns Over Iran, Hamas: No Global Warming Alarm in the U.S., China." 13 June, 2006. Available at http://pewglobal.org/reports/display.php?ReportID=252.

[22] United Nations Framework Convention on Climate Change. "Time Series – Annex I." Available at http://unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3814.php.

[23] Nordhaus, William D. and Joseph Boyer. *Warming the World: Economic Models of Global Warming*. Cambridge: The MIT Press, 2000.

[24] Böhringer, Christian and Carsten Vogt (2002). "Dismantling of a Breakthrough: The Kyoto Protocol – Just Symbolic Policy!" ZEW Centre for European Economic Research, ZEW Discussion Paper 02-25.

[25] Libecap, Gary D. "State Regulation of Open-Access Common-Pool Resources" in *Handbook of New Institutional Economics*, C. Menard and M.M. Shirley (eds). Dordrecht: Springer, 2008; 546.

[26] Alston, Lee J. And Bernardo Mueller. "Property Rights and the State" in *Handbook of New Institutional Economics*, C. Menard and M.M. Shirley (eds). Dordrecht: Springer, 2008; 582.

[27] Bial, Joseph, Daniel Houser, and Gary D. Libecap (2001). "Public Choice Issues in International Collective Action: Global Warming Regulation." Available at http://entrepreneurship.arizona.edu/docs/fac_pubs/Libecap_GlobalWarmingRegulation_2001.pdf.

[28] Schelling, Thomas C. (2005). "What Makes Greenhouse Sense?" *Indiana Law Review* 38: 593.

[29] Lane, Lee and David Montgomery (2008). "Political Institutions and Greenhouse Gas Controls." AEI Center for Regulatory and Market Studies, Related Publication 08-09.

[30] Libecap, Gary D. "State Regulation of Open-Access Common-Pool Resources" in *Handbook of New Institutional Economics*, C. Menard and M.M. Shirley (eds). Dordrecht: Springer, 2008; 546.

[31] Jacoby, Henry D., Mustafa H. Babiker, Sergey Paltsev, and John M. Reilly (2008). "Sharing the Burden of GHG Reductions." *MIT Joint Program on the Science and Policy of Global Change*, Report No. 167.

[32] Barrett, Scott. *Environment & Statecraft: The Strategy of Environmental Treaty-Making.* New York: Oxford University Press, 2003; 379.

[33] Bial, Joseph, Daniel Houser, and Gary D. Libecap (2001). "Public Choice Issues in International Collective Action: Global Warming Regulation;" 2. Available at http://entrepreneurship.arizona.edu/docs/fac_pubs/Libecap_GlobalWarmingRegulation_2001.pdf.

[34] Libecap, Gary D. "State Regulation of Open-Access Common-Pool Resources" in *Handbook of New Institutional Economics*, C. Menard and M.M. Shirley (eds). Dordrecht: Springer, 2008; 568.

[35] Bial, Joseph, Daniel Houser, and Gary D. Libecap (2001). "Public Choice Issues in International Collective Action: Global Warming Regulation;" 18-19. Available at http://entrepreneurship.arizona.edu/docs/fac_pubs/Libecap_GlobalWarmingRegulation_2001.pdf.

[36] Lane, Lee and David Montgomery (2008). "Political Institutions and Greenhouse Gas Controls." AEI Center for Regulatory and Market Studies, Related Publication 08-09.

[37] Arrow, Kenneth J., Linda R. Cohen, Paul A. David, Robert W. Hahn, Charles D. Kolstad, Lee Lane, W. David Montgomery, Richard R. Nelson, Roger G. Noll, Anne E. Smith (2008). "A Statement on the Appropriate Role for Research and Development in Climate Policy." AEI Center for Regulatory and Market Studies, Working Paper 08-12.

[38] Chu, Steven, quoted in: Broder, John M. and Matthew L. Wald. "Big Science Role is Seen in Global Warming Cure." *New York Times*, 12 February, 2009; A24.

[39] Montgomery, David and Anne E. Smith. "Price, Quantity, and Technology Strategies for Climate Change Policy" in *Human-Induced Climate Change*, M. Schlesinger, H. Kheshgi, J. Smith, F. de la Chesnaye, J. Reilly, T. Wilson, and C. Kolstad (eds). New York: Cambridge University Press, 2005.

[40] Arrow, Kenneth J., Linda R. Cohen, Paul A. David, Robert W. Hahn, Charles D. Kolstad, Lee Lane, W. David Montgomery, Richard R. Nelson, Roger G. Noll, Anne E. Smith (2008). "A Statement on the Appropriate Role for Research and Development in Climate Policy." AEI Center for Regulatory and Market Studies, Working Paper 08-12.

[41] Ibid.

[42] Cohen, Linda R. and Roger G. Noll (with Jeffrey S. Banks, Susan A. Edelman, and William M. Pegram). *The Technology Pork Barrel*. Washington, DC: The Brookings Institution Press, 1991.

[43] Arrow, Kenneth J., Linda R. Cohen, Paul A. David, Robert W. Hahn, Charles D. Kolstad, Lee Lane, W. David Montgomery, Richard R. Nelson, Roger G. Noll, Anne E. Smith (2008). "A Statement on the Appropriate Role for Research and Development in Climate Policy." AEI Center for Regulatory and Market Studies, Working Paper 08-12; 3.

[44] Schelling, Thomas C. (2005). "What Makes Greenhouse Sense?" *Indiana Law Review* 38: 581-593; Barrett, Scott. *Environment & Statecraft: The Strategy of Environmental Treaty-Making*. New York: Oxford University Press, 2003.

[45] de Bruin, Kelly C., Rob B. Dellink, and Richard S.J. Tol (2007). "AD-DICE: An Implementation of Adaptation in the DICE Model." FEEM Working Paper 51.2007.

[46] Repetto, Robert (ed). *Punctuated Equilibrium and the Dynamics of U.S. Environmental Policy*. New Haven: Yale University Press, 2006.

[47] Lane, Lee L., Ken Caldeira, Robert Chatfield, and Stephanie Langhoff. "Workshop Report on Managing Solar Radiation." NASA Ames Research Center, Carnegie Institute of Washington Department of Global Ecology: NASA/CP-2007-214558, 18-19 November, 2006. Report published by NASA in 2007.

[48] Ibid.

[49] Ibid.

[50] Arrow, Kenneth J., Linda R. Cohen, Paul A. David, Robert W. Hahn, Charles D. Kolstad, Lee L. Lane, W. David Montgomery, Richard R. Nelson, Roger G. Noll, Anne E. Smith (2008). "A Statement on the Appropriate Role for Research and Development in Climate Policy." *AEI Center for Regulatory and Market Studies*, Working Paper 08-12.